



Touching the future

Sensors and screens are replacing push buttons as touch controls get more sophisticated and user-friendly.

by Terry Costlow

TRW integrated a number of electronic controls into this prototype center panel to simplify operation without sacrificing style.

Simple knobs and push buttons have been a key element in interior design for decades, but there is nothing simple about them anymore. They are now part of a human-machine interface (HMI) that includes everything from aesthetic appearance to vehicle safety.

The transition from push button to a techy term like HMI highlights the ongoing changes in electronic controls. Design teams must now respond to consumer demands to link their portable equipment to a vehicle that is already laden with options like navigation.

Controlling all these devices requires a focused effort at creating a homogeneous environment that is easy to understand and remember even though drivers are doing many tasks, some of them done only rarely. That is forcing developers to work with many different groups so their HMI integrates smoothly with the look and feel of the overall interior.

"There's a trend towards increasing collaboration between OEMs and suppliers, which brings greater understanding of a holistic design," said Michael Tschirhart, HMI Innovation Manager for Visteon Corp.

While appearance is a critical part of the design, ease of use is becoming increasingly more important. Driver distraction is an enormous issue, so there is a huge effort to employ controls that drivers do not have to look at.

"We're starting to see OEMs ask for haptic features on touch screens,

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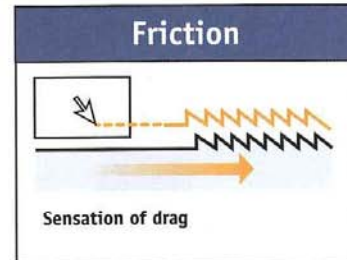
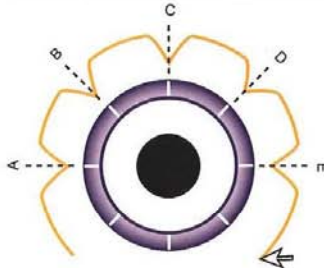
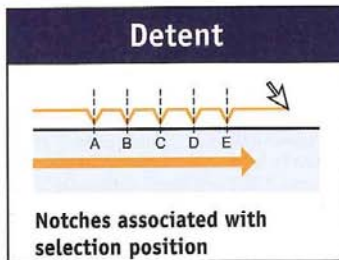


Visteon controls light up when a hand gets near the control panel.



TRW's capacitive switches provide flat surfaces that feature lighting and haptics.

Below: Immersion adds haptic feedback that helps drivers differentiate switches without looking at them.



assigning different feelings to different buttons," said Mark Peters, Director of Engineering & Program Management of Car Multimedia Division at Bosch. "If you don't have haptics, you have to watch [from the sidelines]."

Another way to avoid driver distraction is to put a strong design focus on ease of use. Nothing is gained when car owners cannot figure out how to use fancy features.

"A key issue is how to transport information so a driver can quickly learn while playing with it or have something with a very quick learning cycle, especially when you're talking about rental cars," said Gerd Gottwald, Director, Automotive Systems Integration at Bosch.

Feeling the gentle touch

To drivers, a push button is little more than a button. But that button took scores of labor hours of effort by a team of developers. These developers are rapidly moving to digital technologies, with capacitive sensing currently getting interest in many camps.

Engineers are employing capacitive sensors because they give interiors a smooth surface that can be largely unnoticeable until the driver reaches over to touch one of the buttons. Since capacitive technologies can sense proximity, these switches can be illuminated only when necessary.

"When the driver's hand moves to the center panel, we adjust the lights," Tschirhart said. "Then when the hand moves toward the climate control instead of the radio, we illuminate those aspects."

Another benefit is that this digital technology can be programmed for various models of a vehicle. That makes it simpler for developers to add or remove switches without making entry-level customers feel like they are missing features.

"Consumers hate to see empty button holes," said Mike Blicher, Automotive Technology Director at Immersion. "OEMs can avoid that by using capacitive sensors and displays. They can change the features for different models. This also gives design stu-

dios the option of redesigning over the lifetime of a vehicle."

Capacitive switches can be used for rotary controls, not just push buttons. That maintains the motions now used to adjust radio volume or fan speed while also leveraging the user experience found in many consumer products.

However, designers often need to add features to reduce driver distraction. Reducing the amount of time drivers must glance from the road to find and manipulate controls is a primary concern.

"When you've got controls similar to the [classic] iPod's rotary function, you can put the capacitive switch behind plastic and use the plastic to provide a surface that guides your finger along the rotary path so you don't have to take your eyes off the [road]," said Scott Morrison, Principal Product Engineer for Capacitive Touch Sensing at TRW Automotive.

Many other factors may come into play when switches are selected. Using solid-state technologies eliminates the gaps that are now found in vehicles that

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Interior designers get inside your mind

The requisite blend of technology and psychology makes designing a human-machine interface (HMI) vastly different from the rest of the interior. Seating, comfort, and, to a degree, even styling are well understood after decades of experience.

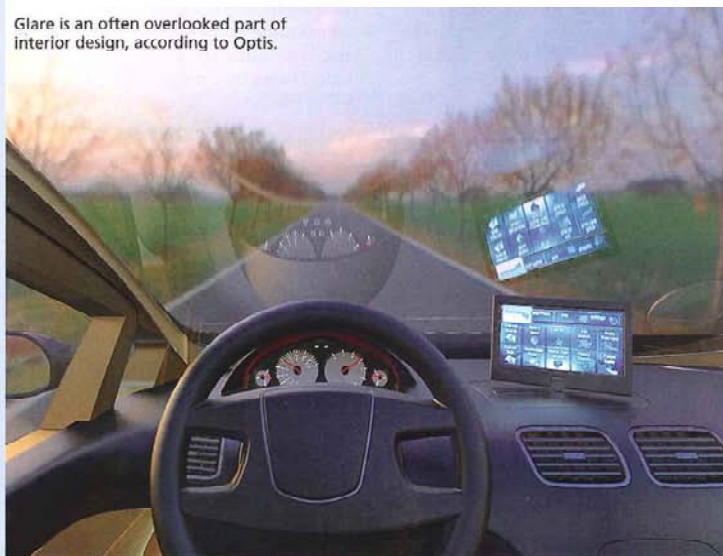
But figuring out how people want to control MP3 players, cell phones, nav systems, and

other equipment while they are focusing on the difficult task of controlling a car involves many disciplines. The interaction between ergonomists, psychologists, engineers, and stylists involves a number of trade-offs.

That means HMI teams must go well beyond the usual mix of engineers and stylists that typically dominate interior-design groups.



Glare is an often overlooked part of interior design, according to Optis.



"HMIs are very multidimensional, so we need a lot of skills—aesthetics, design, cognitive loads, human factors," said Michael Tschirhart, HMI Innovation Manager for **Visteon** Corp. His doctorate in cognitive psychology underscores the diversity needed today.

As more consumer products become part of the automotive environment, automakers are struggling to create HMIs that give all their vehicles a common look and feel while providing the controls used in consumer electronics. That means HMI developers need to reach out to other industries.

"There's a lot of crosstalk between automotive OEMs and consumer electronics providers," said Mike Blicher, Automotive Technology Director at **Immersion**.

At present, cell phones are a widely publicized aspect of HMI that demonstrate the two major issues confronting those charged with blending psychology and engineering. Designers must deal with two types of distraction. Physical distraction occurs when the user handles the phone to dial, answer, or text. Cognitive distraction happens while users talk on the phone.

"Hands-free systems reduce physical distraction by allowing consumers to keep their eyes on the road and hands on the wheel," said Mark Zeinstra, Director of Telematics and Connectivity at **Johnson Controls**. "Texting, dialing, and even looking for your phone while driving are more distracting than using a well-designed hands-free system to place and answer a call."

In other facets of HMI design, positioning LCD and other displays poses a critical challenge for HMI developers. They spend plenty of time watching drivers' eyes to determine how to design controls and feedback mechanisms such as screens so that those eyes do not stray from the highway.

"One technique for shortening the glance time is to set displays closer to the driver's field of vision, even going to head-up displays," said Gerd Gottwald, Director of Automotive Systems Integration at **Bosch**.

As displays are designed, even factors like glare come into play. When teams are positioning screens and control panels, they are using a range of tools, including specialized software from suppliers such as **Optis** that help designers in many fields understand optical issues.

"SPEOS gives results in the actual simulation of contrast ratios and luminance levels, enabling quantifiable analysis," said Pete Moorhouse, Marketing Vice President at Optis. "The software will not only diagnose problems but also enable the engineer to determine the best solution."

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use conventional push buttons.

Over time, many drivers prefer flat surfaces because they eliminate the dust that accumulates between buttons and their surroundings. "People like touch-sensitive switches because they can keep them clean," Tschirhart said.

Still another benefit is that capacitive switches can be configured in a range of shapes. That is true whether they are replacing conventional knobs and switches or being used on touch-sensitive displays.

"Capacitive [technology] can be used on contoured surfaces," Morrison said. "That's a benefit over acoustic wave or IR touch, which are good for flat display screens."

All members of the design team appreciate the pricing that capacitive switches offer. They are often cheaper than older technologies. "The more buttons we replace with capacitive, the better the cost differential with conventional switches," said Carmon McEntaffer, HVAC Engineering Manager at TRW Automotive.

One issue with capacitive switches is that drivers need some way to find them. "You can't use capacitive switches without a visual indicator," said Steve Kingsley-Jones, Automotive Technology Product Manager for Immersion.

Good vibrations

Though solid-state controls offer many benefits, user feedback is not one of them. A growing number of design teams are turning to haptic technologies that provide vibration, force, or other feedback that lets users know when they have manipulated a switch.

Haptic responses can provide an array of feedback options such as bumps, clicks, increasing pressure, or other types of physical response. "People need feedback, either haptically so they can tell what's happening by touch or on a visual basis close to their field of vision," Gottwald said.

Visual responses often are not desirable, since these digital switches are typically in spots such as armrests or low on a center console where they are out of the desired field of view for drivers. One of the simplest haptic techniques is to add detent clicks.

"When you run your finger along a slider, you want to know how far you've gone. If it's three increments, you'll feel three clicks," Blicher said.

Some system designers use sound as an alternative. While it can augment haptics, noise is not always audible. "You can't use sounds as the sole feedback provider," Kingsley-Jones said. "When you're on the phone or there's loud traffic noise, you can't hear the tones."

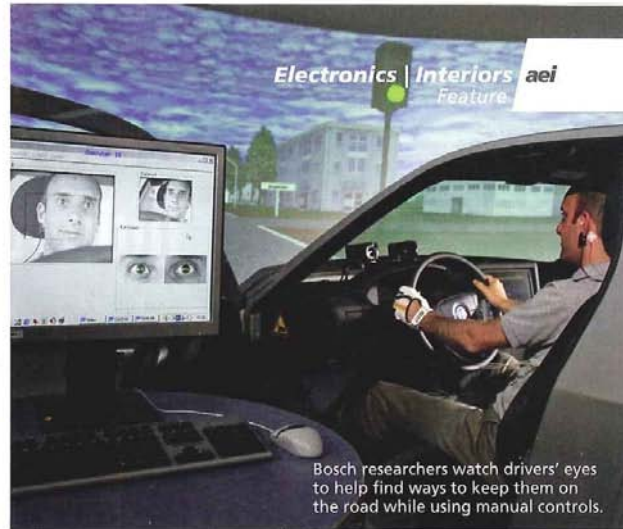
When buttons are in close proximity, for radio and climate controls high on a center stack, for example, responses can assure drivers that they have touched the right control. One might have detents, while another might vibrate, for example.

"Haptics gives you feedback so the air-conditioning button feels different than the radio button," Kingsley-Jones said.

Many Tier 1 suppliers and OEMs are giving haptics a growing role in their HMI portfolios. Solution providers feel that these responses may become part of a brand's differentiation strategy, or even standard ways to alert drivers.

"We see a time when companies will actually brand haptics," Blicher said. "We also believe there will be some warnings that will be ISO standards—haptics that are just like the icons you get for oil or tire pressure alerts." **aei**

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Voice systems still not good enough listeners

Voice control is widely viewed as the ultimate human-machine interface (HMI) for cars, letting drivers control many functions without taking their eyes off the road. But until voice-recognition technology becomes more conversational, its role will be somewhat limited.

Voice control systems such as Ford's Sync are seeing increasing use, but today's systems all require certain command words. Voice control is exciting and effective for many drivers, but several observers feel widespread acceptance will not come until drivers can control functions in the many ways that are comfortable for them. That includes saying the "ah," "um," and pausing as they think.

That will not be possible until voice-recognition software has higher efficiency rates, understanding far more words spoken in the difficult automotive environment.

"Today's recognition rates aren't really adequate," said Mark Peters, Director of Engineering & Program Management of the Car Multimedia Division at Bosch. "Certainly everyone agrees that voice lets you exchange a lot of information in a short time, but low recognition rates are why it hasn't seen more growth."

Even when recognition rates rise and technologies can understand the context of conversations, voice will not be used to control everything in a car. Simple tasks are likely to remain under manual control.

"There's a place for voice, but it's not for changing radio stations or adjusting air conditioning," said Steve Kingsley-Jones, Automotive Technology Product Manager for Immersion.

System designers must also account for the times when even the best voice-recognition system cannot understand what drivers are saying. Knobs, push buttons, and other physical controls will be needed to back up some voice-controlled functions.

"Even if everything is controlled by voice, people will want some alternatives so they can do things manually if the voice system doesn't understand their request," said Gerd Gottwald, Director of Automotive Systems Integration at Bosch.

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